

**What Is Claimed Is:**

- 1        1. A method for performing a minimum computation for an interval  
2 operation, comprising:  
3            receiving at least four floating-point numbers, including a first floating-  
4 point number, a second floating-point number, a third floating-point number and a  
5 fourth floating-point number; and  
6            computing a minimum of the at least four floating-point numbers;  
7            wherein if the at least four floating-point numbers include one or two  
8 default NaN (not-a-number) values and the remaining values are not default NaN  
9 values, the default NaN values are ignored in computing the minimum.
- 1        2. The method of claim 1,  
2            wherein the minimum is a left endpoint of a resulting interval of the  
3 interval operation;  
4            wherein the first floating-point number is the result of an operation  
5 between the left endpoint of a first interval and the left endpoint of a second  
6 interval;  
7            wherein the second floating-point number is the result of the operation  
8 between the left endpoint of the first interval and the right endpoint of the second  
9 interval;  
10          wherein the third floating-point number is the result of the operation  
11 between the right endpoint of the first interval and the left endpoint of the second  
12 interval; and  
13          wherein the fourth floating-point number is the result of the operation  
14 between the right endpoint of the first interval and the right endpoint of the second  
15 interval.

1           3.     The method of claim 1, wherein computing the minimum involves  
2     setting the minimum to a value representing the empty interval, if any of the at  
3     least four floating-point numbers contain the value representing the empty  
4     interval.

1           4.     The method of claim 3, wherein the value representing the empty  
2     interval is a non-default NaN value.

1           5.     The method of claim 2, wherein computing the minimum involves  
2     setting the minimum to negative infinity if the first floating-point number is a  
3     default NaN value and the fourth floating-point number is the default NaN value.

1           6.     The method of claim 2, wherein computing the minimum involves  
2     setting the minimum to negative infinity if the second floating-point number is a  
3     default NaN value and the third floating-point number is the default NaN value.

1           7.     The method of claim 1, wherein if none of the at least four  
2     floating-point numbers is a default NaN value or a value representing the empty  
3     interval, computing the minimum involves selecting the minimum of the at least  
4     four floating-point numbers.

1           8.     The method of claim 2, wherein the operation can include one of a  
2     multiplication operation and a division operation.

1           9.     A method for performing a maximum computation for an interval  
2     operation, comprising:

3 receiving at least four floating-point numbers, including a first floating-  
4 point number, a second floating-point number, a third floating-point number and a  
5 fourth floating-point number; and  
6 computing a maximum of the at least four floating-point numbers;  
7 wherein if the at least four floating-point numbers include one or two  
8 default NaN (not-a-number) values and the remaining values are not default NaN  
9 values, the default NaN values are ignored in computing the maximum.

1 10. The method of claim 9,  
2 wherein the maximum is a right endpoint of a resulting interval of the  
3 interval operation;  
4 wherein the first floating-point number is the result of an operation  
5 between the left endpoint of a first interval and the left endpoint of a second  
6 interval;  
7 wherein the second floating-point number is the result of the operation  
8 between the left endpoint of the first interval and the right endpoint of the second  
9 interval;  
10 wherein the third floating-point number is the result of the operation  
11 between the right endpoint of the first interval and the left endpoint of the second  
12 interval; and  
13 wherein the fourth floating-point number is the result of the operation  
14 between the right endpoint of the first interval and the right endpoint of the second  
15 interval.

1 11. The method of claim 9, wherein computing the maximum involves  
2 setting the maximum to a value representing the empty interval, if any of the at

3 least four floating-point numbers contain the value representing the empty  
4 interval.

1 12. The method of claim 11, wherein the value representing the empty  
2 interval is a non-default NaN value.

1 13. The method of claim 10, wherein computing the maximum  
2 involves setting the maximum to positive infinity if the first floating-point number  
3 is a default NaN value and the fourth floating-point number is the default NaN  
4 value.

1 14. The method of claim 10, wherein computing the maximum  
2 involves setting the maximum to positive infinity if the second floating-point  
3 number is a default NaN value and the third floating-point number is the default  
4 NaN value.

1 15. The method of claim 9, wherein if none of the at least four  
2 floating-point numbers is a default NaN value or a value representing the empty  
3 interval, computing the maximum involves selecting the maximum of the at least  
4 four floating-point numbers.

1 16. The method of claim 10, wherein the operation can include one of  
2 a multiplication operation and a division operation.

1 17. A computer-readable storage medium storing instructions that  
2 when executed by a computer cause the computer to perform a method for

3 performing a minimum computation for an interval operation, the method  
4 comprising:  
5 receiving at least four floating-point numbers, including a first floating-  
6 point number, a second floating-point number, a third floating-point number and a  
7 fourth floating-point number; and  
8 computing a minimum of the at least four floating-point numbers;  
9 wherein if the at least four floating-point numbers include one or two  
10 default NaN (not-a-number) values and the remaining values are not default NaN  
11 values, the default NaN values are ignored in computing the minimum.

1 18. The computer-readable storage medium of claim 17,  
2 wherein the minimum is a left endpoint of a resulting interval of the  
3 interval operation;  
4 wherein the first floating-point number is the result of an operation  
5 between the left endpoint of a first interval and the left endpoint of a second  
6 interval;  
7 wherein the second floating-point number is the result of the operation  
8 between the left endpoint of the first interval and the right endpoint of the second  
9 interval;  
10 wherein the third floating-point number is the result of the operation  
11 between the right endpoint of the first interval and the left endpoint of the second  
12 interval; and  
13 wherein the fourth floating-point number is the result of the operation  
14 between the right endpoint of the first interval and the right endpoint of the second  
15 interval.

1        19.     The computer-readable storage medium of claim 17, wherein  
2 computing the minimum involves setting the minimum to a value representing the  
3 empty interval, if any of the at least four floating-point numbers contain the value  
4 representing the empty interval.

1        20.     The computer-readable storage medium of claim 19, wherein the  
2 value representing the empty interval is a non-default NaN value.

1        21.     The computer-readable storage medium of claim 18, wherein  
2 computing the minimum involves setting the minimum to negative infinity if the  
3 first floating-point number is a default NaN value and the fourth floating-point  
4 number is the default NaN value.

1        22.     The computer-readable storage medium of claim 18, wherein  
2 computing the minimum involves setting the minimum to negative infinity if the  
3 second floating-point number is a default NaN value and the third floating-point  
4 number is the default NaN value.

1        23.     The computer-readable storage medium of claim 17, wherein if  
2 none of the at least four floating-point numbers is a default NaN value or a value  
3 representing the empty interval, computing the minimum involves selecting the  
4 minimum of the at least four floating-point numbers.

1        24.     The computer-readable storage medium of claim 18, wherein the  
2 operation can include one of a multiplication operation and a division operation.

1           25. A computer-readable storage medium storing instructions that  
2 when executed by a computer cause the computer to perform a method for  
3 performing a maximum computation for an interval operation, the method  
4 comprising:

5           receiving at least four floating-point numbers, including a first floating-  
6 point number, a second floating-point number, a third floating-point number and a  
7 fourth floating-point number; and

8           computing a maximum of the at least four floating-point numbers;

9           wherein if the at least four floating-point numbers include one or two  
10 default NaN (not-a-number) values and the remaining values are not default NaN  
11 values, the default NaN values are ignored in computing the maximum.

1           26. The computer-readable storage medium of claim 25,  
2 wherein the maximum is a right endpoint of a resulting interval of the  
3 interval operation;

4           wherein the first floating-point number is the result of an operation  
5 between the left endpoint of a first interval and the left endpoint of a second  
6 interval;

7           wherein the second floating-point number is the result of the operation  
8 between the left endpoint of the first interval and the right endpoint of the second  
9 interval;

10          wherein the third floating-point number is the result of the operation  
11 between the right endpoint of the first interval and the left endpoint of the second  
12 interval; and

13          wherein the fourth floating-point number is the result of the operation  
14 between the right endpoint of the first interval and the right endpoint of the second  
15 interval.

1           27.   The computer-readable storage medium of claim 25, wherein  
2 computing the maximum involves setting the maximum to a value representing  
3 the empty interval, if any of the at least four floating-point numbers contain the  
4 value representing the empty interval.

1           28.   The computer-readable storage medium of claim 27, wherein the  
2 value representing the empty interval is a non-default NaN value.

1           29.   The computer-readable storage medium of claim 26, wherein  
2 computing the maximum involves setting the maximum to positive infinity if the  
3 first floating-point number is a default NaN value and the fourth floating-point  
4 number is the default NaN value.

1           30.   The computer-readable storage medium of claim 26, wherein  
2 computing the maximum involves setting the maximum to positive infinity if the  
3 second floating-point number is a default NaN value and the third floating-point  
4 number is the default NaN value.

1           31.   The computer-readable storage medium of claim 25, wherein if  
2 none of the at least four floating-point numbers is a default NaN value or a value  
3 representing the empty interval, computing the maximum involves selecting the  
4 maximum of the at least four floating-point numbers.

1           32.   The computer-readable storage medium of claim 26, wherein the  
2 operation can include one of a multiplication operation and a division operation.

1           33. An apparatus that performs a minimum computation for an interval  
2 operation, comprising:  
3           an input that is configured to receive at least four floating-point numbers,  
4 including a first floating-point number, a second floating-point number, a third  
5 floating-point number and a fourth floating-point number; and  
6           a computing mechanism that is configured to compute a minimum of the  
7 at least four floating-point numbers;  
8           wherein if the at least four floating-point numbers include one or two  
9 default NaN (not-a-number) values and the remaining values are not default NaN  
10 values, the default NaN values are ignored in computing the minimum.

1           34. The apparatus of claim 33,  
2           wherein the minimum is a left endpoint of a resulting interval of the  
3 interval operation;  
4           wherein the first floating-point number is the result of an operation  
5 between the left endpoint of a first interval and the left endpoint of a second  
6 interval;  
7           wherein the second floating-point number is the result of the operation  
8 between the left endpoint of the first interval and the right endpoint of the second  
9 interval;  
10          wherein the third floating-point number is the result of the operation  
11 between the right endpoint of the first interval and the left endpoint of the second  
12 interval; and  
13          wherein the fourth floating-point number is the result of the operation  
14 between the right endpoint of the first interval and the right endpoint of the second  
15 interval.

1       35.     The apparatus of claim 33, wherein the computing mechanism is  
2 configured to set the minimum to a value representing the empty interval, if any of  
3 the at least four floating-point numbers contain the value representing the empty  
4 interval.

1       36.     The apparatus of claim 25, wherein the value representing the  
2 empty interval is a non-default NaN value.

1       37.     The apparatus of claim 34, wherein the computing mechanism is  
2 configured to set the minimum to negative infinity if the first floating-point  
3 number is a default NaN value and the fourth floating-point number is the default  
4 NaN value.

1       38.     The apparatus of claim 34, wherein the computing mechanism is  
2 configured to set the minimum to negative infinity if the second floating-point  
3 number is a default NaN value and the third floating-point number is the default  
4 NaN value.

1       39.     The apparatus of claim 33, wherein if none of the at least four  
2 floating-point numbers is a default NaN value or a value representing the empty  
3 interval, the computing mechanism is configured to select the minimum of the at  
4 least four floating-point numbers.

1       40.     The apparatus of claim 34, wherein the operation can include one  
2 of a multiplication operation and a division operation.

1       41. An apparatus that performs a maximum computation for an  
2 interval operation, comprising:  
3           an input that is configured to receive at least four floating-point numbers,  
4 including a first floating-point number, a second floating-point number, a third  
5 floating-point number and a fourth floating-point number; and  
6           a computing mechanism that is configured to compute a maximum of the  
7 at least four floating-point numbers;  
8           wherein if the at least four floating-point numbers include one or two  
9 default NaN (not-a-number) values and the remaining values are not default NaN  
10 values, the default NaN values are ignored in computing the maximum.

1       42. The apparatus of claim 41,  
2 wherein the maximum is a right endpoint of a resulting interval of the  
3 interval operation;  
4           wherein the first floating-point number is the result of an operation  
5 between the left endpoint of a first interval and the left endpoint of a second  
6 interval;  
7           wherein the second floating-point number is the result of the operation  
8 between the left endpoint of the first interval and the right endpoint of the second  
9 interval;  
10          wherein the third floating-point number is the result of the operation  
11 between the right endpoint of the first interval and the left endpoint of the second  
12 interval; and  
13          wherein the fourth floating-point number is the result of the operation  
14 between the right endpoint of the first interval and the right endpoint of the second  
15 interval.

1       43.     The apparatus of claim 41, wherein the computing mechanism is  
2 configured to set the maximum to a value representing the empty interval, if any  
3 of the at least four floating-point numbers contain the value representing the  
4 empty interval.

1       44.     The apparatus of claim 43, wherein the value representing the  
2 empty interval is a non-default NaN value.

1       45.     The apparatus of claim 42, wherein the computing mechanism is  
2 configured to set the maximum to positive infinity if the first floating-point  
3 number is a default NaN value and the fourth floating-point number is the default  
4 NaN value.

1       46.     The apparatus of claim 42, wherein the computing mechanism is  
2 configured to set the maximum to positive infinity if the second floating-point  
3 number is a default NaN value and the third floating-point number is the default  
4 NaN value.

1       47.     The apparatus of claim 41, wherein if none of the at least four  
2 floating-point numbers is a default NaN value or a value representing the empty  
3 interval, the computing mechanism is configured to select the maximum of the at  
4 least four floating-point numbers.

1       48.     The apparatus of claim 42, wherein the operation can include one  
2 of a multiplication operation and a division operation.